BESCHWERDEKAMMERN DES EUROPÄISCHEN PATENTAMTS

BOARDS OF APPEAL OF THE EUROPEAN PATENT OFFICE

CHAMBRES DE RECOURS DE L'OFFICE EUROPEEN DES BREVETS

Internal distribution code:
(A) [ ] Publication in OJ
(B) [ ] To Chairmen and Members
(C) [X] To Chairmen
(D) [ ] No distribution

Datasheet for the decision of 1 August 2006

Case Number: T 0647/05 - 3.2.05

Application Number: 96931353.5

Publication Number: 0921921

IPC: B29C 35/08

Language of the proceedings: EN

Title of invention:
Method for heating and/or cross-linking of polymers and apparatus therefor

Patentee:
Uponor Wirsbo AB

Opponent:
Corelco

Headword:
-

Relevant legal provisions:
EPC Art. 54, 56, 57, 83

Keyword:
"Sufficiency of disclosure (yes)"
"Industrial applicability (yes)"
"Novelty (yes)"
"Inventive step (yes)"

Decisions cited:
-

Catchword:
-

Europäisches Patentamt | European Patent Office | Office européen des brevets

Beschwerdekammern | Boards of Appeal | Chambres de recours

Case Number: T 0647/05 - 3.2.05

D E C I S I O N
of the Technical Board of Appeal 3.2.05
of 1 August 2006

Appellant: (Opponent)
Corelco
Les Semalons
F-01570 Manziat (FR)

Representative:
Hinterberg, Katherine
Cabinet Germain et Maureau
BP 6153
F-69466 Lyon Cedex 06 (FR)

Respondent: (Patent Proprietor)
Uponor Wirsbo AB
S-730 61 Virsbo (SE)

Representative:
Hall, Robert Leonard
Harrison Goddard Foote
Fountain Precinct
Balm Green
Sheffield S1 2JA (GB)

Decision under appeal:
Decision of the Opposition Division of the European Patent Office posted 17 March 2005 rejecting the opposition filed against European patent No. 0921921 pursuant to Article 102(2) EPC.

Composition of the Board:

Chairman: W. Moser
Members: P. E. Michel
H. Schram

Summary of Facts and Submissions

I. The appellant (opponent) lodged an appeal against the decision of the Opposition Division rejecting the opposition filed against European Patent No. 0 921 921.

II. Oral proceedings were held before the Board of Appeal on 1 August 2006.

III. The appellant requested that the decision under appeal be overturned in its entirety and that the European Patent No. 0 921 921 be revoked.

The respondent (patentee) requested that the decision under appeal be set aside and that the patent be maintained on the basis of the following documents:

(a) main request: claims 1 to 43 of the patent as granted, and claims 44 to 49 presented as main request during oral proceedings; or
(b) first auxiliary request: claims 1 and 19, presented as first auxiliary request during oral proceedings; or
(c) second auxiliary request: claims 1 to 47, filed as third auxiliary request on 30 June 2006; or
(d) third auxiliary request: claims 1 and 19, filed as second auxiliary request on 20 January 2006; or
(e) fourth auxiliary request: claims 1 to 47, filed as fourth auxiliary request on 30 June 2006.

IV. The following documents have been referred to in the appeal proceedings:

D1: GB-A-2 283 489

D2: "The IR Handbook", Philips, front page and pages 5, 11 and 28
D8: US-A-4,234,624
D9: "IRK halogen infrared radiators in the industrial heating process", Philips Lighting, September 1994, pages 1 to 58
D12: Letter from Solaronics AB, dated 2004-12-06

V. The independent claims of the main request of the respondent read as follows:

"1. Process for heating polymer materials, comprising irradiation of said polymer materials with infrared radiation, characterised in that the wave lengths corresponding to the absorption peaks for the polymer material in respect of infrared radiation have been eliminated in the infrared radiation irradiating the polymer material."

"19. Apparatus for heating polymer material, characterised in that the apparatus includes at least one zone with at least one source of infrared radiation for irradiation of the polymer material with infrared radiation in which the wave lengths corresponding to the absorption peaks of the polymer material in respect of infrared radiation have been eliminated."

"39. Process for reconditioning pipes, including the introduction of a lining tube into the pipe which has a length corresponding to the part of the pipe which is to be reconditioned, the lining tube comprising one or several layers of cross-

linked polyethylene and having an outer diameter being smaller than the inner diameter of the pipe, the lining tube being expanded against the walls of the pipe, characterised in that the lining tube is heated by means of infrared radiation in which the wave lengths corresponding to the absorption peaks of the layers in respect of the infrared radiation have been eliminated."

"44. Lining tube for a process according to any of claims 40-42, characterised in that it comprises cross-linked polyethylen having been heated by means of infrared radiation in which wave lengths corresponding to the absorption peaks which polyethylen has in respect of infrared radiation have been eliminated, and in that the tube on its outer side is provided with a layer forming a foam which not yet has been reacted."

"46. Process for manufacturing oriented tubes of polymer material such as polyolefine or PVC, the tubes being heated to a suitable orienting temperature and then expanded and cooled, characterised in that said tube is heated to the suitable orienting temperature by infrared radiation in which the wave lengths corresponding to the absorption peaks of the polymer material have been eliminated."

"48. Composite tube comprising at least one outer layer, at least one intermediate layer and an inner layer, said intermediate layer consisting of polyethylene, characterised in that said outer and said inner layer comprise a plastics material

forming a barrier against oxygen and having a low permeability in respect of peroxide and/or reaction residues of peroxide, said intermediate layer of polyethylene being uniformly cross-linked across the entire thickness of the layer by irradiation by means of infrared radiation in which the wave lengths corresponding to the absorption peaks polyethylene has in respect of infrared radiation have been eliminated."

VI. The appellant has argued substantially as follows in the written and oral proceedings:

The patent in suit does not disclose the invention in a manner sufficiently clear and complete for it to be carried out by a person skilled in the art. In particular, there is no indication of a method for identifying which absorption peaks are to be eliminated. A trial and error method would involve an undue burden, in particular since it is not specified how much heat must be supplied. The patent in suit thus fails to indicate to what extent there must be a mismatch between the wavelengths of the radiation supplied and the absorption peaks of the polymer material.

The invention is not industrially applicable. The elimination of all absorption peaks would prevent sufficient heating.

The subject-matter of claim 1 of the main request of the respondent lacks novelty in view of the disclosure of each of documents D2 and D8.

Document D2 teaches at page 5 the use of short wave infrared radiation for industrial heating in general and at page 28 the use of short wave infrared radiation for heating plastics without causing surface damage. As indicated in Figure 5, short wave infrared means radiation in the range of 0.76 to 2 μm.

Document D8 discloses the use of a lamp for infrared light having wavelengths of about 1.2 μm for heating polyethylene (column 3, lines 45 to 55). This is also specified in the patent in suit at paragraph [0034]. The teaching of document D8 that the polymer should be transparent so as to permit radiation to pass therethrough (column 2, lines 46 to 49; column 4, lines 2 to 8) is equivalent to the elimination of absorption peaks.

The subject-matter of claim 19 of the main request of the respondent lacks novelty in view of the disclosure of each of documents D8 and D9.

The apparatus shown in Figures 1 to 5 of document D8 falls within the scope of claim 1 of the main request.

The apparatus shown at pages 48 and 49 of document D9 is identical with that claimed in claim 19 of the main request. The feature of the claim according to which absorption peaks are eliminated is merely an intellectual step, which is not reflected by corresponding technical features.

Insofar as the subject-matter of claims 1 and 19 of the main request of the respondent is regarded as being novel, it nevertheless lacks an inventive step.

Document D8 is the closest prior art. The problem to be solved is to enable homogeneous heating of the polymer, thus avoiding excessive surface heating.

The solution to this problem is available in document D2, which at page 28, left hand column, lines 8 to 12, proposes the use of short-wave infrared radiation, which, as disclosed in Figure 5 of document D2, has a wavelength of from 0.76 to 2 μm.

Document D1 further suggests the elimination of radiation at unwanted wavelengths when carrying out cross-linking of polymers (page 2, lines 5 to 11).

VII. The respondent has argued substantially as follows in the written and oral proceedings:

The patent in suit discloses the invention in a manner sufficiently clear and complete for it to be carried out by a person skilled in the art. In particular, the person skilled in that art, using routine experimentation, is capable of identifying frequencies for the infrared radiation which will enable the radiation to penetrate to a significant depth before being absorbed, so as achieve uniform heating. This can be achieved either by the use of a filter to remove wavelengths corresponding to the absorption peaks for the polymer material, or by the selection of a heater which does not emit the wavelengths at issue.

Suitable lamps for carrying out the invention are available. If the lamp disclosed in document D9 were

found to cause excessive surface heating, an appropriate filter could be provided.

The invention is industrially applicable. The claims specify that heating of the polymer material occurs. The heating effect may be improved by virtue of the presence of additives in the polymer, or by using reflectors.

Neither of documents D2 and D8 suggests in any way the step of eliminating absorption peaks.

The method and apparatus disclosed in document D8 is only capable of achieving relatively uniform heating by heating of the cable conductor rather than the polymer, which should be transparent. At column 2, lines 18 to 20, it is stated that the main part of the radiation has wavelengths between 0.76 and 4 microns, and thus includes absorption peaks of the polymer material. Whilst the lamp may have a maximum intensity at 1.2 microns, it nevertheless does not avoid absorption peaks. Surface degradation is only avoided by virtue of the presence of the vulcanisation tube.

The subject-matter of claims 1 and 19 is thus novel.

If document D8 is regarded as being the closest prior art, the fact that the radiation includes wavelengths corresponding to absorption peaks of the polymer will lead to scorching at the surface, in particular at the absorption peak which occurs at 3.5 microns, shown at A in Figure 4 of the patent in suit.

There is no suggestion in the prior art of avoiding the absorption peaks for the polymer material.

Document D1 teaches heating at wavelengths which, according to the patent in suit, should be avoided (page 2, lines 5 to 11).

Document D9 shows in Figure 29.3 that the spectrum of the lamp operating at 2200°C includes the wavelength of 3.5 microns.

The subject-matter of claim 1 of the main request thus involves an inventive step.

Reasons for the Decision

Main Request

1. *Sufficiency of disclosure*

In order to carry out the invention, it is necessary first to identify the wave lengths corresponding to the absorption peaks for the polymer material to be heated. It was not contested by the appellant that the person skilled in the art is capable of acquiring a spectrum for a selected polymer material without undue burden.

An infrared source must then be provided in which either these wavelengths have been eliminated by means of one or more filters or in which these wavelengths are not produced. It is considered that a lamp for which the spectrum avoids absorption peaks could be manufactured, for example by virtue of the glass of the

lamp having a filtering effect. Whilst the cited documents do not show an example of an infrared source whose spectrum does not include a wavelength corresponding to an absorption peak for a selected polymer material, it cannot be excluded that such a pairing of a source and a polymer material exists. In the event that a selected lamp was found to include an absorption peak within its spectrum, it would then be necessary to provide an appropriate filter.

In the opinion of the Board, the person skilled in the art is capable of exercising a degree of common sense in selecting which peaks are to be eliminated or avoided. In particular, the largest absorption peaks should be eliminated, whilst nevertheless providing sufficient absorbed radiation. It would be in contradiction to common sense to attempt to eliminate all peaks, however small, thus rendering the polymer transparent to infrared radiation and preventing heating of the polymer material.

The disclosure of the invention is thus sufficient to enable the invention to be carried out by a person skilled in the art.

2. *Industrial applicability*

As stated in point 1 above, the person skilled in the art would not continue to eliminate ever decreasing absorption peaks to the point at which no heating of the polymer material occurs.

The invention can be used in industry and is accordingly regarded as being industrially applicable in accordance with Article 57 EPC.

3. *Novelty*

3.1 Claim 1

Whilst claim 1 specifies that absorption peaks "have been eliminated", the description of the patent in suit makes it clear that not only the use of filters to eliminate absorption peaks is contemplated (see paragraph [0033]), but also, as an alternative to filters, the use of lamps which do not emit infrared light having wavelengths corresponding to absorption peaks may be used (see paragraph [0034]).

Document D8 discloses a process for heating polymer materials by irradiation with infrared radiation. At column 3, lines 50 to 57, it is proposed using a radiation source for heating a LD polyethylene, either operating at 2100°C, thus providing radiation with a maximum intensity at a wavelength of 1.2 microns, or operating at 2700°C, thus providing radiation with a maximum intensity at a wavelength of 1.0 microns.

Whilst this constitutes a teaching of the wavelength at which the radiation has a maximum intensity, there is no disclosure in document D8 of an infrared radiation source whose spectrum does not extend into regions in which an absorption peak for the polyethylene occurs. According to column 2, lines 18 to 20 and 41 to 42, the radiation has for the most part wavelengths between 0.76 and 4 microns. This includes the wavelength of 3.5

microns, which, as shown in Figure 4 of the patent in suit, corresponds to an absorption peak for polyethylene.

The patent in suit also proposes in paragraphs [0034] and [0037] the use of lamps having wavelengths of about 1.2 μm as an alternative to the use of filters for heating polyethylene. However, in the context of the patent in suit, such a lamp must be selected so as to have a spectrum which avoids the absorption peaks of polyethylene.

Document D2 proposes the use of "short-wave IR radiation". Whilst Figure 5 shows the short-wave infrared portion of the electromagnetic spectrum as extending from 0.76 to 2 μm, there is no disclosure of an infrared source whose spectrum is restricted to this range. Thus, Figure 6 shows the spectrum of a short-wave IR quartz lamp as extending beyond a wavelength of 4 μm. Consequently, references throughout document D2 to "short-wave IR radiation", for example at page 28, left hand column, lines 1 to 17, may not be construed as being restricted to radiation whose spectrum is solely within the range of from 0.76 to 2 μm.

It may further be noted that there is no evidence available to the Board that document D2 was made available to the public before the priority date of the patent in suit.

Document D9 discloses an IR radiator for industrial heating having a radiation distribution as illustrated in Figure 8.1. The incandescent temperature is 2400 K, giving rise to a spectrum having a maximum intensity at

a wavelength of around 1.1 microns and a "continuous output over a large wavelength range" (see section 3.1, right hand column, lines 1 and 2).

Document D12 refers to infrared lamps having a peak wavelength at 1.2 μm. The lamps are thus similar to those disclosed in documents D2 and D9.

There is thus no disclosure in the cited prior art of the elimination or avoidance of the use of wavelengths corresponding to absorption peaks.

3.2 Claim 19

Claim 19 is directed to an apparatus for heating polymer material, *inter alia* characterised by the presence of at least one source of infrared radiation in which "infrared radiation in which the wave lengths corresponding to the absorption peaks of the polymer material in respect of infrared radiation have been eliminated". The subject-matter of the claim is thus considered to be novel for the same reasons as claim 1.

3.3 Claims 39 and 46

Independent claim 39 is directed to a process for reconditioning pipes in which a "lining tube is heated by means of infrared radiation in which the wave lengths corresponding to the absorption peaks of the layers in respect of the infrared radiation have been eliminated". Independent claim 46 is directed to a process for heating polymer material using "infrared radiation in which the wave lengths corresponding to the absorption peaks of the polymer material have been

eliminated". The subject-matter of these claims is thus also considered to be novel for the same reasons as claim 1.

3.4 Claims 44 and 48

Claim 44 relates to a lining tube which "on its outer side is provided with a layer forming a foam which not yet has been reacted." Claim 48 relates to a composite tube having at least one outer and an inner layer which "comprise a plastics material forming a barrier against oxygen and having a low permeability in respect of peroxide and/or reaction residues of peroxide", and an intermediate layer of cross-linked polyethylene. None of the cited prior art discloses such lining tubes or composite tubes.

3.5 The subject-matter of all the independent claims is thus novel.

4. *Inventive step*

4.1 Closest prior art

The closest prior art is represented by document D8, the disclosure of which is discussed above under point 3.1.

4.2 Problem and Solution

A problem which arises in the process and in use of the apparatus of document D8 is that, by virtue of the fact that radiation is strongly absorbed by the polymer material, excessive heating takes place at the surface

of the material, and the radiation does not penetrate through the thickness of the polymer material. Damage of the surface layer results. This problem is discussed in the patent in suit at paragraph [0012].

The person skilled in the art is thus faced with the problem of reducing surface damage of the surface of the polymer material.

According to the patent in suit, this problem is solved by the use of infrared radiation at wavelengths which do not coincide with absorption peaks of the material.

There is no suggestion in the cited prior art to the effect that wavelengths corresponding to absorption peaks for the polymer material in respect of infrared radiation should be avoided or eliminated in the infrared radiation irradiating the polymer material.

As discussed above under point 3.1, document D2 does not suggest anything other than a short-wave infrared source whose spectrum extends into the medium-wave portion of the spectrum, as illustrated in Figure 6.

Document D9 discloses a lamp having a spectrum as illustrated in Figure 8.1. This spectrum has a peak at around 1.1 μm and also includes the wavelength of 3.5 μm. The use of such a lamp in the apparatus of document D8 would thus not result in the avoidance or elimination of wavelengths corresponding to absorption peaks of the polymer material.

Document D1 discloses the use of infrared radiation "in a band having its peak at the peak frequency of the

emission/absorbtion band for the curing reaction for the said system" (claim 1), thus avoiding waste heat (page 2, lines 5 to 11). This document thus points away from the concept of the present invention, which accepts a less efficient absorption of the radiation in order to enable the radiation to penetrate below the surface layer of the polymer material.

The subject-matter of claims 1, 19, 39 and 46 thus involves an inventive step.

As stated under point 3.4 above, no prior art has been cited which discloses the lining tube of claim 44 or the composite tube of claim 48. Claims 2 to 18, 20 to 38, 40 to 43, 45, 47 and 49 are dependent claims which relate to preferred embodiments of the subject-matter of the independent claims. The subject-matter of the remaining claims thus also involves an inventive step.

5. In view of the above, it is not necessary to consider the auxiliary requests of the respondent.

Order

For these reasons it is decided that:

6. The decision under appeal is set aside.

7. The case is remitted to the first instance with the order to maintain the patent on the basis of the following documents:

(a) claims 1 to 43 of the patent as granted, and claims 44 to 49 presented as main request during oral proceedings;

(b) description, pages 2 to 7 of the patent as granted; and

(c) drawings, pages 17 to 21 of the patent as granted.

The Registrar: The Chairman:

D. Meyfarth W. Moser